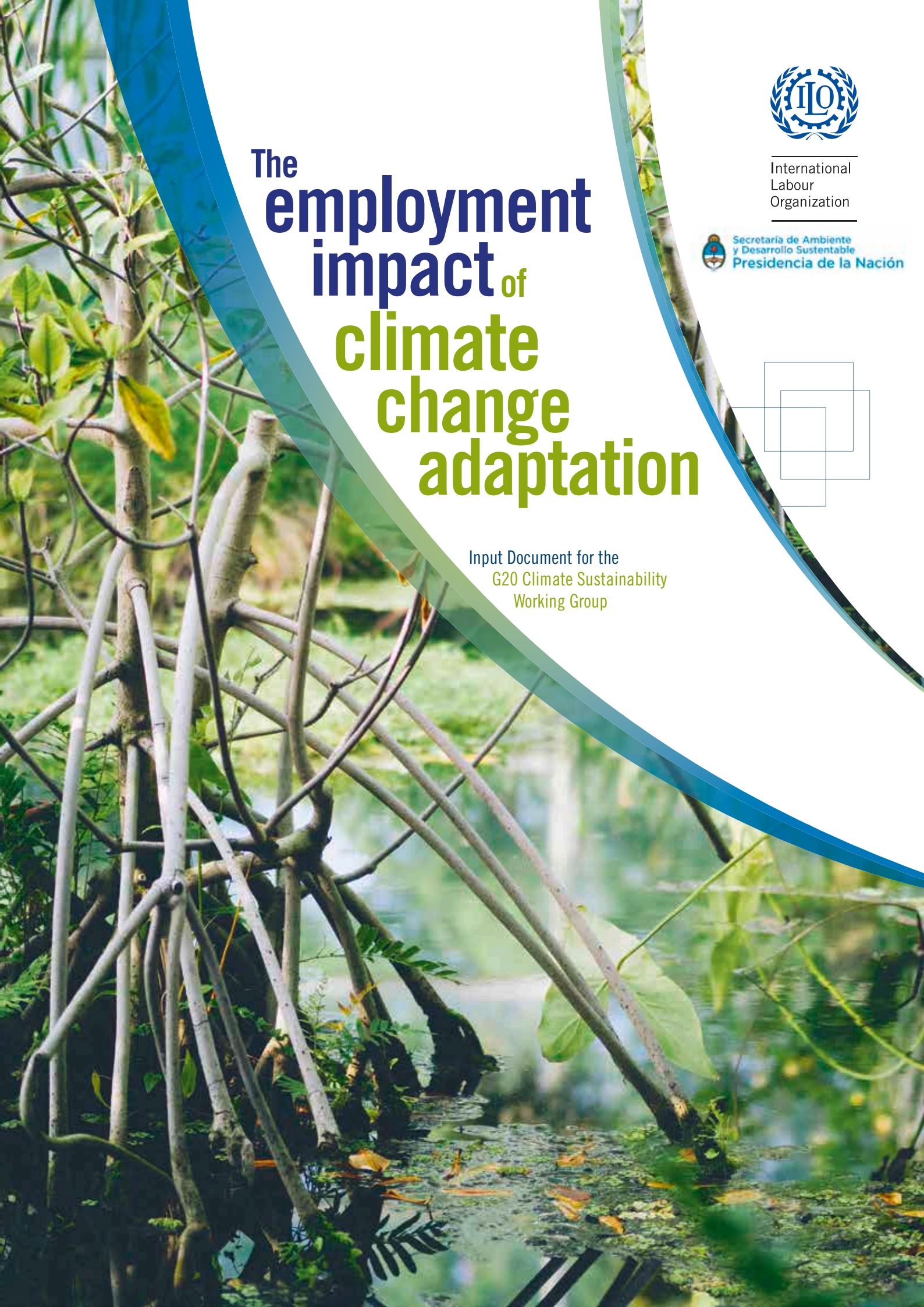

The employment impact of climate change adaptation

Input Document for the
G20 Climate Sustainability
Working Group

International Labour Organization

Secretaría de Ambiente y Desarrollo Sustentable
Presidencia de la Nación

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Input Document for the G20 Climate Sustainability Working Group

A report prepared by the International Labour Organization (ILO) for the G20 Climate Sustainability Working Group (CSWG) under the Argentine G20 Presidency in 2018

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Foreword

This report has been prepared by the International Labour Organization (ILO) as a contribution to the work of the G20 Climate Sustainability Working Group (CSWG), under the Argentine G20 Presidency in 2018.

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The opinions expressed and arguments employed in this report are the sole responsibility of the authors and do not necessarily represent those of the G20 members.

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Executive summary

The world of work is intimately connected with the natural environment. Around one third of jobs in the G20 countries rely directly on the effective management and sustainability of a healthy environment. Climate change and other forms of environmental degradation have already caused net negative impacts on jobs and work productivity, and these impacts are expected to become more pronounced in the coming decades. Temperature increases can, for example, make heat stress more widespread, thus reducing the total number of work-hours. The effects of climate change also have specific implications for women and, in particular, for the challenge of achieving gender equality in the world of work. Differences in social and economic roles and responsibilities exacerbate the vulnerability of women, migrants, youth, indigenous and tribal peoples, people in poverty and people with disabilities, all of whom tend to have lower access to resources for climate change adaptation, including land, credit, agricultural inputs, the support of decision-making bodies, technology, social insurance and training. For the majority of such individuals working in the informal economy and in small enterprises, it is especially difficult to recover from the effects of environmental disasters.

Quantitative simulations indicate that climate change mitigation has the potential to keep future adaptation costs down and bring net employment benefits through, inter alia, a substantial reallocation of labour. However, whatever mitigation efforts are undertaken, the impacts of climate change are already making themselves felt and they are not expected to diminish in the near future. Thus, adaptation measures are called for and it is worth emphasizing that these can also lead to employment creation. Adaptation measures include, but are not restricted to, the development of natural and built infrastructures to protect individuals and communities against natural hazards. Depending on their design, such infrastructures can generate employment opportunities far beyond the construction sector.

Adaptation measures should be designed so as to take into account gender equity concerns. Furthermore, community participation and social dialogue in the design and implementation of such measures can help reinforce local development and employment creation.

Social protection and skills development policies increase adaptive capabilities and can protect individuals and communities faced with natural hazards against income and food insecurity. They can also help displaced workers and workers directly affected by climate-related hazards. More generally, the labour regulatory framework can support adaptation policies by offering solutions to cope with environmentally induced stress at work, environmentally induced migration, and the challenge of providing compensation and protection for workers in the sectors affected, as well as by making tools available for the diversification of economies.

Negative effects of climate change and extreme weather events on employment

- Some forms of environmental degradation may have a direct negative effect on the world of work. When considering the relationship between the world of work and climate change, one should take into account at least three key aspects:
  - Jobs in general rely on the services that ecosystems provide. Climate change threatens the provision of many of these vital ecosystem services and thus endangers the jobs that depend on them.
  - Both jobs as such and the provision of safe, healthy and decent working conditions rely on the absence of environmental hazards and the maintenance of environmental stability.
  - The risks and hazards associated with environmental degradation tend to affect vulnerable workers the most.

- The increasing frequency and intensity of various environment-related hazards caused or exacerbated by human activity have already reduced labour productivity. Between 2000 and 2015, 23 million working-life years were lost annually at the global level as a result of such hazards. Among the members of the G20, China, Brazil and India were the most affected countries, with respectively 8.7, 3.2 and 1.5 working-life years lost per person per year during the period 2008–15.
- Projected temperature increases will make heat stress more common, reducing the total number of work-hours in the G20 countries by 1.9 per cent by 2030, with a greater effect on agricultural workers and on workers in emerging countries.
- Currently, 34 per cent of jobs in the G20 countries rely directly on ecosystem services and, hence, on effective and sustainable management of the environment. This includes jobs in farming, fishing and forestry, and all those that rely on natural processes, such as air and water purification, soil renewal and fertilization, pollination, pest control, the moderation of extreme temperatures, and the protection provided by natural infrastructure (e.g. forests) against storms, floods and strong winds. Environmental degradation threatens these ecosystem services and the jobs that depend on them.

Adaptation measures can create jobs and protect workers and income

- The transition to a low greenhouse gas economy is expected to lead to a net creation of jobs. Climate change mitigation can keep future adaptation costs down and bring about net employment creation through, inter alia, a substantial reallocation of labour. However, irrespective of the mitigation efforts that may be undertaken, climate change-related events are already having a profound impact and this is expected to continue. Thus, adaptation to climate change is a challenge which calls for action in the here and now.
- Adaptation measures can lead to employment gains and prevent job losses. Evidence suggests that in Europe around 500,000 additional jobs (approximately 0.2 per cent of the working population) will be directly and indirectly created by 2050 as a result of the increase in adaptation-related activities.
- Investment in adaptation infrastructure is likely to have positive effects on employment, in particular because of the increased demand for construction work in projects to reduce climate-related risks. The combined direct, indirect and induced employment effects of investment in adaptation infrastructure vary between countries. For every US$ 1 million invested in the construction sector, close to 650 jobs are expected to be created in India, 200 in China, 160 both in Brazil and in Indonesia, and 120 in the Russian Federation.
- Three out of four jobs worldwide are heavily or moderately dependent on water. Adaptation measures, such as investment in the infrastructure required for the conservation, treatment and supply of water, can increase both the number and quality of jobs across the economy.
- Reforestation and afforestation are further effective adaptation measures because of the ability of forests to regulate water flows, act as barriers against storm surges and protect against erosion and mudslides; at the same time, the many other ecosystem services provided by forests create jobs and economic value.
- Skills development is also an adaptation strategy because it helps displaced workers to move on to sectors where there is employment growth, thus protecting them against income losses and other adverse effects of climate change. A shortage of skills would in any case be an obstacle to the implementation of adaptation and mitigation measures.
- Social protection policies are another form of adaptation to climate change. Cash transfers and public employment programmes are two such instruments. By 2030, extended social transfers are expected to lead to an increase in employment rates of 0.2 per cent in developed countries and 0.6 per cent in developing countries.

Accompanying and enabling policies to maximize the positive employment effect of the transition to a climate-resilient economy

The following measures are among those that could be deployed, as appropriate and relevant, to increase the positive impacts of climate resilience on employment:

- A national legal framework that integrates environmental with labour-related objectives can go a long way towards ensuring that climate change adaptation and mitigation measures are also employment friendly.
- Social dialogue can play an important role in maximizing the employment effect of adaptation to climate change. It is important to give due consideration to international labour standards when designing climate change adaptation policies.
- Micro-, small- and medium-sized enterprises are important partners in climate change adaptation because they are well placed to develop locally relevant effective adaptation solutions.
- Sharing best practices and improving tools and methods for identifying the employment benefits specifically attributable to adaptation investments would help to ensure that any such investments lead to productive and inclusive growth. This could be done, for example, by systematically comparing the employment outcomes of investments that include an adaptation component with those of investments that do not. Another possibility is to include green jobs in labour force surveys, which would account for jobs in mitigation- and adaptation-related activities. There are several methodologies available for assessing employment impacts along these lines, such as that developed by the Green Jobs Assessment Institutions Network (GAIN).

Introduction

In recent decades, humanity has increased its pressure on the environment beyond what is sustainable. The resource- and greenhouse gas (GHG)-intensive model of development that has largely been followed so far has led to various forms of environmental degradation, including climate change, scarcity of natural resources, air and water pollution, soil degradation, biodiversity loss and changes in biochemical flows. All of these affect the world of work directly and negatively.

There is scientific consensus on the alteration of global climate that has taken place as a result of human interference (i.e., climate change), as evidenced by the observed increases in global mean air and sea temperatures, in the rate of melting of glaciers, and in global mean sea level. Changes in climate have caused, and will continue to cause, impacts on natural and human systems, including peoples and societies around the world (IPCC, 2014).

Climate change and other forms of environmental degradation[1] have already caused net negative impacts on jobs and work productivity, and these impacts are expected to become more pronounced in the coming decades. Climate change may lead to job and work productivity losses because it increases the frequency of extreme weather events and, more generally, threatens the provision of ecosystem services. Disasters take lives away and destroy infrastructure, resulting in job and productivity losses. Higher temperatures are expected to worsen working conditions and reduce labour productivity (ILO, 2018a). Changing temperature and rain patterns are bound to affect entire industries, notably agriculture, and extreme weather events will likely disrupt such sectors as transport and tourism. Rising sea levels may displace entire communities and lead to the salinization of agricultural land. Ocean acidification and changing ocean temperatures and currents decrease the ability of coral reefs to provide storm protection, limit biodiversity and alter the distribution and productivity of fisheries. The most severe impacts are expected to occur in economic sectors that are very reliant on highly climate-sensitive resources (such as agriculture, for example), and in areas frequently afflicted by extreme weather events (IPCC, 2014).

Mitigation and adaptation efforts are required to limit the effects and impacts of climate change. Understanding the relation of such efforts to employment and the world of work is critical in order to integrate environmental and social objectives. Mitigation measures can limit the effects of climate change and reduce future adaptation costs, while bringing net employment benefits. However, no matter what mitigation efforts are undertaken, climate change-related events are expected to continue to take place. The implementation of adaptation measures is therefore a matter of genuine urgency.

Adaptation refers to anticipating the negative effects of environmental degradation and taking suitable action to prevent or minimize the damage these effects can cause. Investing in adaptation and developing climate-resilient infrastructure are prerequisites for economic growth, job creation and advancing towards sustainable development. Adaptation to climate change can lead to job creation and prevent the loss of jobs, as well as bringing other employment benefits. It is important to bear this in mind and to pursue complementary policies in order to maximize the positive employment impact of adaptation strategies.

1. This report focuses on the employment impact of adaptation to climate change as well as to other forms of environmental degradation, because it is difficult to distinguish between adaptation measures specifically designed to address environmental degradation attributable to climate change and those designed to address deterioration of the environment caused by other factors.

There are several different types of adaptation measures, each with its own specific impacts on employment, and they include:

- Protection and restoration of natural infrastructure: for example, conservation activities and afforestation programmes to restore certain adaptation-relevant ecosystem services;
- Projects focusing on built infrastructure: for example, building irrigation infrastructure to limit the effect of changing rain patterns on crops; building flood defences and raising the levels of dikes; and adapting buildings to future climatic conditions and extreme weather events;
- Capacity-building activities: for example, skills development programmes can help displaced workers to move on to sectors where there is employment growth, thus protecting them against income losses and other adverse effects of climate change;
- Financial support: for example, social protection mechanisms to come to the aid of people affected by natural disasters or climate events.

There are stark inequalities regarding the likelihood of suffering from the damages caused by climate change, even though the latter affects all countries negatively. Thus, people in poverty, women, youth, migrants, indigenous and tribal peoples, persons with disabilities and other vulnerable groups are the most exposed to the negative consequences of climate change. At the same time, these groups can also make important contributions towards combating climate change. For instance, indigenous women play a vital role in the sustainable management of natural resources because of the traditional knowledge they in particular help to preserve (ILO, 2017d). At the national level, developing countries and small island developing States are confronted with significant risks (IPCC, 2014). The consumption patterns and stages of development of the above-mentioned groups of people and countries mean that their contribution to climate change is relatively low, yet they are the ones having to bear the heaviest burden of its consequences (IPCC, 2014).

The risks associated with climate change have specific implications for women and, in particular, for the challenge of achieving gender equality in the world of work. Differences in social and economic roles and responsibilities exacerbate the vulnerability of women, migrants, youth, indigenous and tribal peoples, people in poverty and persons with disabilities, all of whom tend to have lower access to resources for climate change adaptation, including land, credit, agricultural inputs, the support of decision-making bodies, technology, social insurance and training. For the majority of such individuals working in the informal economy and in small enterprises, it is especially difficult to recover from the effects of environmental disasters (ILO, 2009; 2017d; IPCC, 2014). The impacts of climate change may, together with the exclusion of women from adaptation and mitigation actions, aggravate the various obstacles and socio-economic vulnerabilities that lead to decent work deficits among women. The development of green sectors, in addition to ensuring a just transition of the workforce and of enterprises, including those involved in adaptation measures, also has great potential to help overcome gender disparities, as long as equality of opportunity and treatment is established as a specific goal from the outset.

Climate change adaptation presents various opportunities to address instances of sectoral and occupational segregation, to narrow wage and skills gaps in certain sectors and occupations, to promote inclusive social dialogue, to improve working conditions, and to enhance social protection. At the same time, adaptation-related transformations and the redefinition of jobs and workplaces can further improve skills, and reduce health and safety risks – both areas in which female workers are often at a disadvantage. Moreover, the creation of new labour market opportunities can help formalize the various jobs performed by women in the informal economy. Ensuring a just transition to a low-GHG and sustainable economy would mean that women are not left behind, and that their existing and potential contributions, which are essential for sustainable development and for the success of adaptation measures, are not undermined (ILO, 2017c).

1. Negative effects of climate change and extreme weather events on employment

This section explores the ways in which climate change is linked to the world of work. In view of the close connection between the latter and the natural environment, it highlights how climate change and extreme weather events can negatively affect employment and work productivity.[1] First of all, the impact of environment-related hazards and rising temperatures on jobs and productivity is quantified. The section then estimates the number of jobs that rely on ecosystem services and are thus at risk from climate change and other forms of environmental degradation.

1.1 Key messages

- Some forms of environmental degradation may have a direct negative effect on the world of work. When considering the relationship between the world of work and climate change, one should take into account at least three key aspects:
  - Jobs in general rely on the services that ecosystems provide. Climate change threatens the provision of many of these vital ecosystem services and thus endangers the jobs that depend on them.
  - Both jobs as such and the provision of safe, healthy and decent working conditions rely on the absence of environmental hazards and the maintenance of environmental stability.
  - The risks and hazards associated with environmental degradation tend to affect vulnerable workers the most.
- The increasing frequency and intensity of various environment-related hazards caused or exacerbated by human activity have already reduced labour productivity. Between 2000 and 2015, 23 million working-life years were lost annually at the global level as a result of such hazards. Among the members of the G20, China, Brazil and India were the most affected countries, with respectively 8.7, 3.2 and 1.5 working-life years lost per person per year during the period 2008–15.
- Projected temperature increases will make heat stress more common, reducing the total number of work-hours in the G20 countries by 1.9 per cent by 2030, with a greater effect on agricultural workers and on workers in emerging countries.
- Currently, 34 per cent of jobs in the G20 countries rely directly on ecosystem services and, hence, on effective and sustainable management of the environment. This includes jobs in farming, fishing and forestry, and all those that rely on natural processes, such as air and water purification, soil renewal and fertilization, pollination, pest control, the moderation of extreme temperatures, and the protection provided by natural infrastructure (e.g. forests) against storms, floods and strong winds. Environmental degradation threatens these ecosystem services and the jobs that depend on them.

1. Disasters and heat stress are used to illustrate the impact of climate change on the world of work. The effects of climate change are varied and each impinges on the world of work in its own way, as noted in the introduction. For a comprehensive treatment of the multiple effects of climate change on economies and societies, see IPCC, 2014.

1.2 Linkages between climate change and the world of work

In seeking to understand the relationship between the world of work and climate change there are at least three key aspects to bear in mind:

- **Directly and indirectly, jobs rely on the services that ecosystems provide** (e.g., jobs in agriculture, fisheries, forestry and tourism). Climate change threatens the provision of many of these vital services (e.g., freshwater provision, biodiversity, storm protection, stock renewal), affecting negatively the economic activities and jobs that rely on them. Among these negative effects is also a reduction in labour productivity.
- **Jobs and good working conditions rely on the absence of environmental hazards** (such as storms and air pollution) and the maintenance of environmental stability (e.g., temperatures staying within a particular range and predictable precipitation patterns). Climate change, in so far as it affects temperature and rain patterns, may render entire regions unproductive and make workplaces too hot for work, thereby leading to climate-induced migration, the proliferation of precarious and informal work, and an increase in unemployment.
- **The risks and hazards associated with environmental degradation tend to affect vulnerable workers the most**, including women, migrant workers, people in poverty, indigenous and tribal peoples, persons with disabilities and other disadvantaged groups depending on the country or region, thereby generating and perpetuating inequality.

1.3 Working-life years are lost because of human-induced or climate change-related disasters

The overall trend in climate change effects is towards an increase in the frequency and magnitude of climate-related natural disasters (IPCC, 2014). Hazards become disasters when they overwhelm local risk management capacity. They destroy jobs, force people to migrate and slow down economic activity as a result of the destruction of capital stock, transport systems and other infrastructure. Although rebuilding capital stock after a disaster may stimulate the growth of gross domestic product (GDP) and employment, the short- and long-term economic consequences of disasters are negative, particularly for developing and smaller economies (Felbermayr and Gröschl, 2014; Noy, 2014).

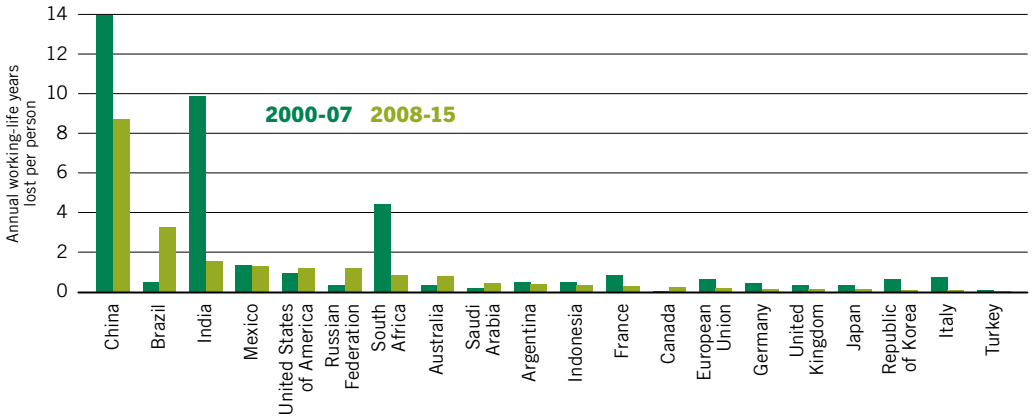
A country's vulnerability to disasters depends on both its exposure to hazards as such and its ability to reduce their impacts through climate change adaptation measures. In particular, the impact of disasters on jobs and productivity can be mitigated by implementing adequate climate change adaptation and risk management measures.

Every death of a person of working age, every disability and every damage to infrastructure resulting from a disaster reduces the productive potential of several generations. The ILO estimates that between 2000 and 2015, 23 million working-life years were lost annually as a result of various environment-related hazards caused or exacerbated by human activity.[2] This is equivalent to 0.8 per cent of a year's work, considering that 2.8 billion people aged 15 to 64 are in employment in any given year. These disasters include all human-induced disasters that have resulted in environmental damage (e.g., industrial accidents) and natural hazards known to be intensified by climate change (e.g., cyclones).

Among G20 countries, China, India and South Africa suffered the greatest loss of working-life years due to human-induced or climate change-related disasters between 2000 and 2007, with, respectively, 13.9, 9.8 and 4.4 working-life years lost per person per year (Figure 1). Between 2008 and 2015, China, Brazil and India were the most affected

2. The above estimate is based on Noy's (2014) estimates for total life years lost due to disasters. Noy's methodology is adapted to take into account retirement and the population in employment in each country. For further details on the methodology, refer to Appendix 1 in ILO, 2018.

Figure 1. Working-life years lost as a result of human-induced or climate change-related disasters by country, G20 countries, 2000–07 and 2008–15



Note: The estimates used to prepare this figure take into consideration casualties, people affected and damages resulting from meteorological (storms, fog, extreme temperatures), hydrological (floods, landslides, wave action), climatological (drought, glacial lake outbursts, wildfires), certain biological (insect infestation) and certain technological (industrial or miscellaneous accidents) hazards. They do not take into account casualties, people affected or damages resulting from geophysical (earthquakes, mass movements, volcanic activity), certain biological (viral, bacterial, parasitic, fungal or prion disease epidemics, animal accidents), extraterrestrial (asteriod, meteroid and comet impacts, space weather) or other technological (transport accidents) hazards. The methods used follow Noy's (2014) approach, with adjustments made for retirement age and national employment-to-population ratios. See Appendix 1 in ILO *World Employment and Social Outlook: Greening with Jobs* (2018) for the methodological details underlying the calculations.

Source: ILO calculations based on Noy (2014) and data from the Emergency Events Database (EM-DAT), the Global Health Observatory, United Nations population statistics, the World Development Indicators, the World Economic Outlook database and the ILOSTAT database.

countries, with, respectively, 8.7, 3.2 and 1.5 working-life years lost per person per year. The effects of environment-related hazards increased in Brazil, the Russian Federation, the United States of America, Australia, Saudi Arabia and Canada between the 2000–07 and 2008–15 periods. The large decrease observed in China, India and South Africa if one compares the two periods is due to the fact that of the eight biggest disasters (in terms of working-life years lost) among the G20 countries during the years 2000–15, six occurred in the 2000–07 period: the 2002 drought in India, the 2004 drought in South Africa, the 2002, 2003 and 2007 floods in China, and the 2002 storm in China.

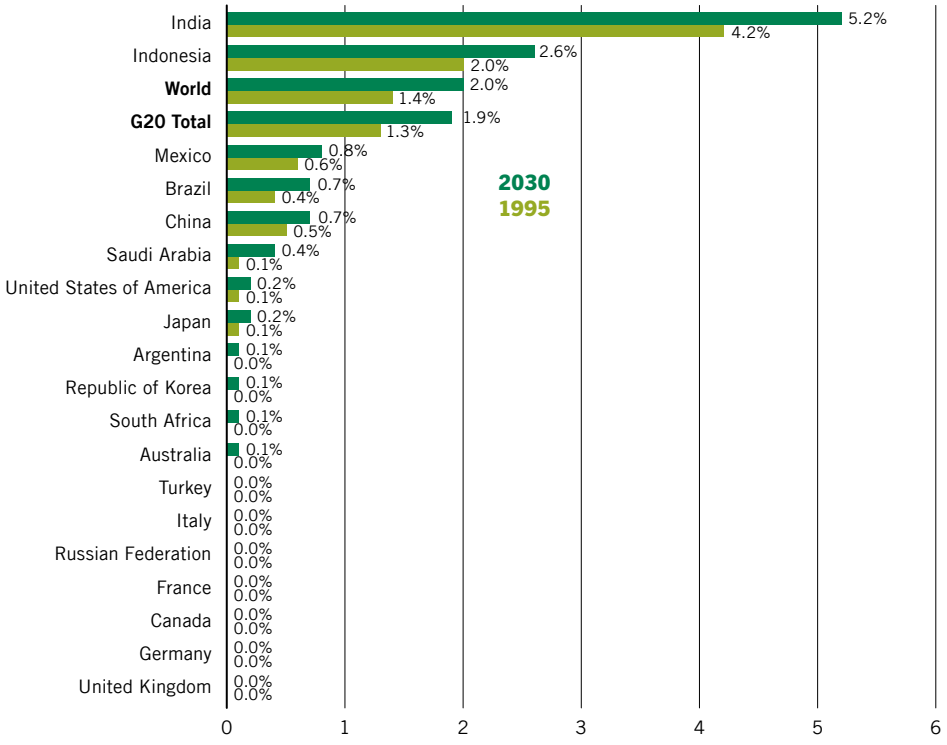
1.4 Rising temperatures will continue to increase heat stress and lower labour productivity

During the course of this century, a significant proportion of the more than 4 billion people who live in hot areas could experience negative health and safety effects, as well as reduced work capacity, as a result of human-induced climate change (Kjellström et al., 2016).

Increasing temperatures mean that workers need to spend a greater proportion of their work-hours getting some rest and cooling down their bodies in order to maintain the core body temperature below 38°C and avoid heat stroke. The increasing prevalence of heat stress reduces worker performance, partly because slowing down is a natural defence mechanism against heat exposure. Work capacity diminishes when the wet bulb globe temperature[3] exceeds 26°C (Kjellström, Holmer and Lemke, 2009). As one of the consequences of climate change, heat stress will continue to reduce productivity and give rise to negative occupational health effects and workplace injuries, particularly in the countries most exposed to extreme heat, in sectors that rely on outside and daytime work (e.g., agriculture and

3. Wet bulb globe temperature (WBGT) is a recognized index of heat stress used in occupational health. Developed by the US Army, it takes into account temperature, humidity, wind speed, sun angle and cloud cover. Occupational health standards combine WBGT with work intensity to determine acceptable levels of heat exposure associated with different types of work (ISO, 1989, 2017).

Figure 2. Percentage of work-hours lost owing to heat stress under a 1.5°C scenario, selected G20 countries, 1995–2030



Note: See Appendix 1 in ILO *World Employment and Social Outlook: Greening with Jobs* (2018) for details of the methodology used to estimate the impact of climate change on work-hours.

Source: ILO calculations based on ILOSTAT and the HadGEM2-ES and GFDL-ESM2M climate models.

construction), and in workplaces where insufficient adaptation measures have been taken (e.g., factories without effective cooling systems) (Kovats and Hajat, 2008).

Heat stress is an occupational safety and health hazard, as indicated in manuals produced by responsible public bodies around the world,[4] and it should be treated as such by workers, employers and governments, in accordance with the Occupational Safety and Health Convention, 1981 (No. 155), and the accompanying Recommendation, 1981 (No. 164).

Globally, 1.4 per cent of the total hours worked were lost in 1995 because of high heat levels, which is equivalent to around 35 million full-time jobs worldwide (ILO, 2018a). Assuming a global temperature rise of 1.5°C by the end of the century (in the best-case scenario), estimates based on labour force trends suggest that, by 2030, the percentage of total hours of work lost owing to heat stress may rise to 2.0 per cent, a labour productivity loss equivalent to 72 million full-time jobs. This is most likely an underestimate because it depends on the increase in global mean temperature being no more than 1.5°C and assumes that agricultural work is carried out in the shade.

Figure 2 illustrates how the projected negative impact of rising temperatures is expected to reduce the total number of work-hours in the G20 countries by 1.9 per cent by 2030. However, the estimated impact is unevenly distributed across these countries. It is expected that India and Indonesia will be the most affected, with a reduction in total hours worked of 5.2 per cent and 2.6 per cent, respectively. By contrast, Turkey, Italy, the Russian Federation, France, Canada, Germany and the United Kingdom are expected to experience only a small impact, with a reduction in work-hours of less than 0.1 per cent in each case. Nevertheless, as a result of the projected rise in temperatures during that period, labour productivity losses due to heat stress are expected to have increased in all G20 countries in 2030 relative to 1995.

4. See, for example, the information materials on heat stress produced by the Ontario Ministry of Labour (https://www.labour.gov.on.ca/english/hs/pubs/gl_heat.php), the UK Health and Safety Executive (http://www.hse.gov.uk/pubns/indg451.htm) and the US Occupational Safety and Health Administration (https://www.osha.gov/SLTC/heatstress/).

Agricultural workers will be the worst affected, accounting for 66 per cent of the projected global hours lost owing to heat stress in 2030 (ILO, 2018a). This is a consequence of the physical nature of their work and the fact that it is undertaken outside, and also because a large number of workers are engaged in agriculture in the areas most likely to be affected by heat stress in the future. With projected temperature increases beyond 1.5°C, as would be the case under a business-as-usual scenario, some of these areas could even become unproductive, resulting in the displacement of a large number of workers. This also has significant implications for gender equality if one bears in mind that over 60 per cent of all working women in southern Asia and sub-Saharan Africa are employed in agriculture, and that these women are often unpaid or poorly paid for their time- and labour-intensive activities (ILO, 2016; ILO, 2017c).

1.5 Several millions of jobs rely on services provided by the environment

Ecosystems provide services to economies and individuals through natural processes. These services include the purification of air and water, the generation and renewal of soil and soil fertility, the pollination of crops, the control of agricultural pests, the moderation of extreme temperatures, protection against storms, floods and wind, support for diverse human cultures and aesthetic beauty (Daily, 1997).[5] The absence or loss of these services is prejudicial not just to health and well-being (Millennium Economic Assessment, 2005), but also to economic activity (Kumar (ed.), 2010) because it puts jobs at risk (GHK Consulting, CE and IEEP, 2007; Rademaekers et al., 2012). Measures to mitigate environmental degradation or to adapt to its consequences can, however, protect jobs in the sectors affected, especially in agriculture. Around one third of industrial sectors have strong links with ecosystem services (GHK Consulting, CE and IEEP, 2007). Climate change is one form of environmental degradation which can limit the provision of certain ecosystem services, because of shifting biomes, increased frequency and intensity of natural hazards, changing rain and temperature patterns, changing distribution of disease vectors, changes in ocean currents, ocean acidification, and other effects (IPCC, 2014).

In 2014, around 1.2 billion jobs, accounting for 40 per cent of total world employment, were sustained by industries that depend directly or heavily on ecosystem services (table 1). These sectors include agriculture, forestry, fishing, food, drink and tobacco, wood and paper, biofuels and renewable energy sources, the pharmaceutical and chemical industries, and environment-related tourism. The share of employment that relies on ecosystem services varies widely across the G20 countries, with India, China and Indonesia having the highest proportions, at 52, 50 and 41 per cent, respectively. In the United Kingdom and Germany, respectively, 5 and 6 per cent of total employment relies directly on ecosystem services; while in the European Union (EU) as a whole the proportion is as high as 16 per cent.

These estimates take into account only employment that is directly dependent on the provision of ecosystem services (for example, farmers, but not shop assistants selling seeds or lorry drivers transporting products). However, ecosystem services also support other types of job indirectly through industries that depend on, or provide inputs for, those jobs (ITUC, 2015). If, as a result of a loss of ecosystem services, activity falls in these sectors, they may have a lower capacity to supply inputs to downstream industries and to demand output from upstream industries, indirectly affecting even more jobs.

5. In the Millennium Ecosystem Assessment (2005) and Kumar (ed.) (2010) four classes of ecosystem services are identified: provisioning services (e.g., food, water, wood for timber and fuel); regulating services (e.g., water purification, climate regulation); supporting services (e.g., soil formation and nutrient cycling); and cultural services (e.g., spiritual, cultural and aesthetic uses).

Table 1. Proportion of jobs relying on ecosystem services, selected G20 countries, 2014

Country	Number of jobs relying on ecosystem services (thousands)	Total number of jobs (thousands)	Proportion of jobs relying on ecosystem services (%)
Argentina (urban)*	926*	11 047*	8*
Australia	989	10 839	9
Brazil	20 290	89 368	23
Canada	1 275	17 269	7
China	325 145	653 843	50
European Union	71 084	434 445	16
France	2 128	27 100	8
Germany	2 768	42 674	6
India	193 727	375 559	52
Indonesia	47 549	114 839	41
Italy	2 427	22 577	11
Japan	4 814	53 152	9
Korea, Republic of	2 953	25,797	11
Mexico	11 882	51 158	23
Russian Federation	8 713	63 624	14
South Africa	1 374	12 468	11
Turkey	7 813	24 562	32
United Kingdom	1 611	31 363	5
United States of America	10 396	149 415	7
G20	708 929	2 087 385	34
World	**1 231 684**	**3 114 301**	**40**

*The estimates for Argentina are based on the 2014 Permanent Household Survey, which covers only the main cities. It is therefore likely that the number of jobs relying on ecosystem services in the country has been underestimated. The estimates presented are an average of the estimates for each quarter.

Note: Only industries in which the activity has a significant and substantial link to the environment were taken into account. These sectors include agriculture, forestry, fishing, food, drink and tobacco, wood and paper, biofuels and renewable energy sources, the pharmaceutical and chemical industries, and environment-related tourism. The identification of these linkages is taken from GHK Consulting, CE and IEEP (2007). The volume of the environment-related tourism sector, following ibid., is estimated to be 30% of the total volume of the hotel and restaurant sector.

Source: ILO calculations based on EXIOBASE (version 3), ILO (2015a), GHK Consulting, CE and IEEP (2007) and Rademaekers et al. (2012).

Greenhouse gas-induced changes in temperature and rain patterns have a direct impact on the growth cycle of plants and the length of the growing season, affecting market prices, and ultimately farmers' income. Although some crops may benefit from higher carbon dioxide (CO_2) concentrations in the air, this does not offset the negative effects of extreme weather events and climate variability. Lower yields in agriculture may create further incentives for land-use change and deforestation, further increasing GHG accumulation in the atmosphere (IPCC, 2014). Box 1 outlines some of the effects of climate change on major crops. Without vigorous adaptation measures, farmers practising rain-fed agriculture in vulnerable regions could end up being displaced or have little choice but to migrate.

Box 1. The impact of climate change on agriculture

Agriculture is one of the sectors that will be most affected by climate change. A major impact has to do with conditions in the areas suitable for growing major crops.

An average temperature rise of over 2°C above pre-industrial levels will, without adaptation, negatively impact maize, wheat, rice, cocoa, coffee and tea yields in tropical and temperate regions, all of which support the livelihoods of millions of farmers (Bhagat, Baruah and Safique, 2010; Bongase, 2017; Bunn et al., 2015; ILO, 2012; IPCC, 2014; Renteria, 2016; Schroth et al., 2016; Wildenberg and Sommeregger, 2016). In most of the agricultural land in the Andean region, 80 per cent of crops will be affected by climate change by 2050 (CIAT, 2014). Although negative effects prevail for the world as a whole, projections suggest a higher likelihood of positive effects on crop yields in northern latitudes (IPCC, 2014).

Agricultural production is one of the most important traditional economic activities in the Andean region, accounting for 13, 10, 7 and 6.5 per cent of GDP in the Plurinational State of Bolivia, Ecuador, Peru and Colombia, respectively (World Bank, 2013). These are among the main regional providers of raw materials and food to G20 countries.

An average temperature rise of over 4°C will pose serious risks for food security (IPCC, 2014). Rainfall is predicted to decrease in the already dry semi-arid to arid mid-latitudes and in the interior of large continents. By 2030 nearly half the world's population will live in areas of high water stress, and water scarcity will force the displacement of hundreds of millions of people (IPCC, 2014). The greatest impacts will be on rain-fed agriculture, which currently accounts for around 60 per cent of the world's agricultural production and takes up 96 per cent of cultivated land in sub-Saharan Africa, 87 per cent in South America and 61 per cent in Asia (FAO, 2011). This will have important consequences for economic growth and development (Brown et al., 2011).

2. Adaptation measures can create jobs and protect workers and income

This section explores the employment impact of climate change adaptation. It covers investment in physical and natural infrastructure as well as adaptation in the form of capacity building and social protection. In all its forms, adaptation can have positive effects on employment.

2.1 Key messages

- The transition to a low-GHG economy is expected to lead to a net creation of jobs. Climate change mitigation can keep future adaptation costs down and bring about net employment creation through, inter alia, a substantial reallocation of labour. However, irrespective of the mitigation efforts that may be undertaken, climate change-related events are already having a profound impact and this is expected to continue. Thus, adaptation to climate change is a challenge which calls for action in the here and now.
- Adaptation measures can lead to employment gains and prevent job losses. Evidence suggests that in Europe around 500,000 additional jobs (approximately 0.2 per cent of the working population) will be directly and indirectly created by 2050 as a result of the increase in adaptation-related activities.
- Investment in adaptation infrastructure is likely to have positive effects on employment, in particular because of the increased demand for construction work in projects to reduce climate-related risks. The combined direct, indirect and induced employment effects of investment in adaptation infrastructure vary between countries. For every US$ 1 million invested in the construction sector, close to 650 jobs are expected to be created in India, 200 in China, 160 both in Brazil and in Indonesia, and 120 in the Russian Federation.
- Three out of four jobs worldwide are heavily or moderately dependent on water. Adaptation measures, such as investment in the infrastructure required for the conservation, treatment and supply of water, can increase both the number and quality of jobs across the economy.
- Reforestation and afforestation are further effective adaptation measures because of the ability of forests to regulate water flows, act as barriers against storm surges and protect against erosion and mudslides; at the same time, the many other ecosystem services provided by forests create jobs and economic value.
- Skills development is also an adaptation strategy because it helps displaced workers to move on to sectors where there is employment growth, thus protecting them against income losses and other adverse effects of climate change. A shortage of skills would in any case be an obstacle to the implementation of adaptation and mitigation measures.
- Social protection policies are another form of adaptation to climate change. Cash transfers and public employment programmes are two such instruments. By 2030, extended social transfers are expected to lead to an increase in employment rates of 0.2 per cent in developed countries and 0.6 per cent in developing countries.

2.2 Adaptation and mitigation measures can lead to employment gains and prevent job losses

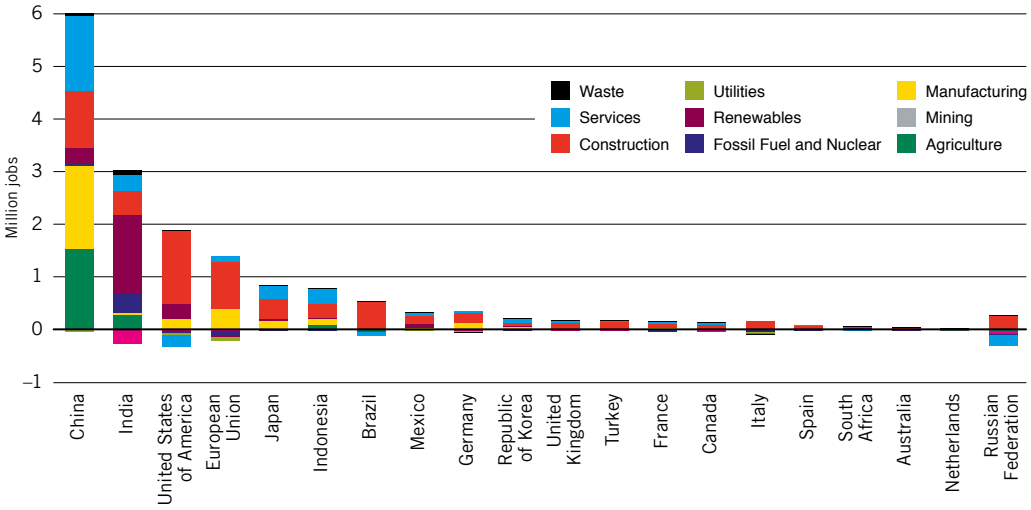
The transition to a low-GHG economy is expected to lead to a net creation of jobs. However, no matter what climate change mitigation efforts are undertaken, unavoidable climate impacts must be reckoned with. Thus, adaptation measures are necessary and these, moreover, have the potential to generate employment.

The ILO (2018a) predicts that the actions taken in the energy, transport[1] and construction sectors to limit global warming to 2°C over the course of the century will have an overall net positive employment impact.[2]

Thus, the pursuit of sustainability in the energy sector would create around 18 million more jobs globally by 2030 compared to what would pertain if the business-as-usual path were continued.[3] Employment creation would be driven by the higher labour demand of renewable energy sources, as well as of the entire value chain associated with renewable energy, electric vehicles and construction of the necessary infrastructure. Such a scenario implies the reallocation of employment across sectors, since employment in utilities, mining and fossil fuel-related industries is expected to decrease.

Figure 3 shows that net job creation is expected to take place in practically all G20 countries by 2030 if they commit themselves to achieving energy sustainability. China, India and the United States of America are expected to experience the highest levels of employment creation, with 6, 2.8 and 1.6 million net jobs created, respectively.

Figure 3. Achieving energy sustainability and its impact on employment in 2030 in G20 countries (millions of jobs)



Notes: This figure illustrates the employment outcomes that could be achieved by 2030 in a scenario of energy sustainability as opposed to the business-as-usual scenario. The energy sustainability scenario combines the IEA's 2°C scenario (IEA, 2015) with projected electric vehicle sales (UBS Research and UBS Evidence Lab, 2017). It further assumes that all energy efficiency savings are invested in construction to retrofit existing buildings. The scenarios are implemented in a multi-regional input–output model. See Appendix 2 in ILO (2018a) for methodological details.

Source: ILO calculations based on EXIOBASE (version 3).

1. Road transport is also a major contributor to air pollution, accounting for about 50 per cent of the total health costs of outdoor air pollution in OECD countries (OECD, 2014).

2. Net job creation refers to the overall impact on job numbers. It takes into account the direct and indirect jobs created and lost. Net jobs are created if, on balance, more jobs are created than are lost.

3. The International Energy Agency (IEA) has developed country-specific scenarios in which the energy sector is decoupled from fossil fuels, and which would limit global warming to 2°C (IEA, 2015). The 6°C scenario is largely a continuation of current trends, a business-as-usual scenario, under which CO_2 emissions would rise by about 60 per cent between 2013 and 2050.

When it comes to the analysis of the **job creation potential of climate change adaptation**, a study organized by the European Commission, has revealed the following:

- Under a reference scenario, around 500,000 additional jobs (approximately 0.2 per cent of the working population) could be directly and indirectly created in the EU by 2050 thanks to the increased adaptation-related expenditures needed to achieve the objectives of the EU Adaptation Strategy, and some 136,000 jobs could be saved from the negative impacts of climate change as a result of these adaptation measures (Triple E Consulting, 2014).[4]
- Projections from an ambitious scenario, under which the amount of adaptation-related expenditures increases to 1 per cent of GDP in the EU by 2050, suggest that around 1 million jobs could be directly and indirectly created and around 330,000 jobs saved by 2050 (ibid.).
- Evidence from European and developing countries indicates that the sectors that are most often included in adaptation strategies are infrastructure (including energy infrastructure), water (including flood-prevention measures), agriculture (including forestry, fisheries and husbandry), biodiversity conservation, and health (Harsdorff, Lieuw-Kie-Song and Tsukamoto, 2011; ILO, 2011, 2015a; Triple E Consulting, 2014).
- Most of the projects envisaged in adaptation plans are related to infrastructure, while most of the jobs created under both the reference and the ambitious scenarios are in business, public services and the construction sector (Triple E Consulting, 2014).

2.3 Investing in climate-resilient infrastructure has a positive impact on employment

There is an urgent need to invest in climate-resilient infrastructure: the costs of failing to maintain and adapt infrastructure so that it can cope with increasing climate change-related impacts are high. For example, the American Society of Civil Engineers estimates that, even without considering the impacts of climate change, failure to make the necessary investments in infrastructure would end up costing the United States of America 2.5 million jobs and US$ 4 trillion in GDP over the period 2016–2025 (ASCE, 2016). If one factors in the impacts of climate change, these losses would be even higher. At the global level, the Organisation for Economic Co-operation and Development (OECD) estimates that annual investments totalling US$ 6.3 trillion would be required between 2016 and 2030 in order to meet development needs across the world. An additional US$ 0.6 trillion would make those investments climate compatible (OECD, 2017).

The higher costs associated with initial investment in resilient infrastructure are likely to be recouped in the long term through reduced expenses on repair work and on disaster response (Knopman et al., 2017). Climate-resilient infrastructure generally means higher initial outlays because of the design and engineering services required to anticipate climate-related risks. However, investing in climate-resilient infrastructure is likely to increase the demand for construction sector output. For example, dikes may need to be heightened and more elevated roads and stronger buildings may have to be constructed in order to withstand more extreme weather events. The employment impact can be separated into three components:

- Direct effects: employment in industries directly targeted by the investment (e.g., construction);
- Indirect effects: employment in industries that supply inputs for infrastructure development (e.g., engineering services, materials and transport);
- Induced effects: employment generated by consumption as the income of firms and households increases.

4. The model used by Triple E Consulting (2014) compares a baseline scenario in which no new adaptation activities are taking place from 2011 onwards with a reference scenario in which new adaptation activities needed to meet the objectives of the EU Adaptation Strategy are implemented. In a second step, an ambitious scenario is compared with the baseline scenario. Under the ambitious scenario, the projected adaptation-related expenditures in 2050 amount to 1 per cent of GDP for all the EU countries, which is twice as high as the proportion assumed for the reference scenario.

Estimating accurately the employment impact of such investments is complicated because of the various effects involved. Table 2, however, gives an idea of the combined direct, indirect and induced employment effects of investment in adaptation infrastructure and how they differ between countries.[5] These differences can be accounted for by the different backward and forward economic linkages in the various countries, and also by the extent to which the construction sector in each country uses inputs produced nationally. For every US dollar spent in the construction sector, total economic output increases by between US$ 2.5 and US$ 5.0 depending on the country. Output multipliers are lowest in Mexico (2.5) and Indonesia (3.3), and highest in the United States of America (5.0), Brazil and the United Kingdom (4.9 in both cases). However, many of the new jobs generated may prove to be of a temporary nature if investments are not sustained over time.

Higher economic activity promoted by investment in the construction sector also translates into higher demand for employment. For every US$ 1 million invested in the construction sector, close to 650 jobs are expected to be created in India, 200 in China, 160 in Brazil and in Indonesia, and 120 in the Russian Federation. Employment multipliers are much lower in France, Germany, Australia, the United States of America and the United Kingdom because of higher wage rates and productivity (Ernst and Sarabia, 2015). Another important indirect effect of investment in climate-resilient infrastructure is that it protects millions of livelihoods by reducing the negative impact of climate change-related events.

Infrastructure investment can also support aggregate demand, and, depending on the macroeconomic context and unemployment rate in a country, give rise to a higher induced job creation effect. The magnitude of the employment impact varies for each infrastructure project, because some projects (e.g., construction of rural roads and refurbishment of buildings) are more labour-intensive than others (e.g., construction of urban highways and new buildings).

Table 2. Construction sector output and employment multipliers for selected G20 countries, 2009

Country	Construction sector output multiplier	Construction sector employment multiplier (for every US$ 1 million invested)
Argentina*	2.6*	*
Australia	4.8	19.4
Brazil	4.9	162.3
Canada	3.6	17.6
China	4.2	198.6
France	4.1	12.7
Germany	3.8	15.1
India	3.9	646.7
Indonesia	3.3	157.5
Italy	4.6	20.7
Japan	4.8	23.3
Korea, Republic of	4.8	57.4
Mexico	2.5	84.4
Russian Federation	4.4	120.6
Turkey	2.5	41.8
United Kingdom	4.9	20.7
United States of America	5.0	21.0

* Argentina was not included in Ernst and Sarabia (2015), and so the estimates of the multipliers for Argentina are based on ECLAC and ILO (2018) and are for the year 2011. Comparable estimates for Saudi Arabia and South Africa were not available.

Source: Ernst and Sarabia (2015).

5. The estimates given in Table 2 are mostly based on data from the World Input–Output Database (WIOD). They can be taken as indicative of the construction of climate change adaptation infrastructure if the processes used to build such infrastructure are not systematically different from those that apply in the general construction sector. It is not easy to identify the specific employment effects of adaptation infrastructure, because infrastructure is not usually constructed for adaptation purposes alone. Certain climate-proofing features can be added to existing infrastructure as part of periodic maintenance and upgrading activities, making it difficult to track their employment effects. In such cases, adaptation is incorporated into general infrastructure design as an additional parameter.

In optimizing the employment impacts of investments in adaptation infrastructure, one should seek to make the construction sector as a whole more employment friendly. The specific measures to be taken will vary considerably from country to country, but they should generally include the following aspects:

- Optimizing the local content of building material inputs;
- Structuring the infrastructure investment portfolio so as to ensure a balance between capital- and labour-intensive projects;
- Planning for countercyclical public investments in the sector;
- Facilitating the access of small and medium-sized enterprises to the sector, in particular to public sector contracts;
- Improving working conditions as well as health and safety in small and medium-sized enterprises;
- Investing in the necessary professional and vocational skills.

2.4 The climate-proofing of infrastructure has important implications for advancing equity and inclusion

Depending on the policy goal, each adaptation strategy can be assessed according to the socio-economic, environmental and risk-reduction benefits it brings, as well as according to the employment opportunities it creates. As a rule, people in poverty are the most affected by climate change and the least able to cover the costs of adaptation. Moreover, their lack of voice and representation makes it difficult for them to secure government support for the development of adaptive infrastructure in the areas where they live. Nevertheless, the ability of disadvantaged communities to assess their own situation and to take the initiative in seeking improvements is often grossly underestimated.

A local resource-based approach to infrastructure development can contribute significantly to a more inclusive labour market, creating jobs and income, and assisting communities to adapt to climate change. For instance, the traditional knowledge of indigenous and tribal peoples is increasingly recognized as being vital to the success of adaptation measures (ILO, 2017d).

Gender-responsive approaches can also contribute towards enhancing the participation of women and furthering gender equality. Adaptation (and mitigation) measures have gender-related implications. Achieving the 2°C long-term goal for temperature rise will not, by itself, improve the female employment share by 2030 because male-dominated industries gain prominence in a 2°C scenario (e.g., renewables, manufacturing, construction). Without taking action to overcome gender disparities in each relevant industrial sector, the share of women in employment will be 0.03 percentage points lower than in a business-as-usual scenario (ILO, 2018b).

As further elaborated below, capacity building must be a key component in any programme that seeks to address climate change at the local level. In some countries, the local institutions tasked with, and the procedures for, dealing with climate change are often inadequate. As far as the refurbishment of buildings and infrastructure is concerned, this requires not only a larger workforce in the construction sector, but also professionals with advanced knowledge of mechanics, construction materials and climate-smart technologies who are able to respond to the growing number of climate-related disasters. The need for new skills is likely to increase in the construction, manufacturing and transport sectors. Strietska-Ilina et al. (2011) note that a shortage of skilled technicians, managers and operators has, for example, been reported in the construction sector in Australia, China, Europe and South Africa. Efforts to promote capacity building and provide technical assistance in establishing forward and backward linkages between environmental impacts and employment challenges in a country-specific context would be helpful. It is necessary to encourage the responsible involvement of business owners in balancing the demand for, and supply of, skills by establishing effective public–private partnerships within the national legislative framework.

2.5 Water-dependent jobs: a key source of investment that spills over across the whole economy

Climate change will alter stream flow regimes, deteriorate water quality, and change spatial and temporal patterns of precipitation and water availability (IPCC, 2014). Because water is integral to human livelihoods, the link between water and jobs is not only direct, but also prompts questions related to human rights, the green economy, sustainable development and gender equality.

The impact of climate change on water resources impinges on several industries because these resources are at the heart of economic activity. Most electricity, for example, is either produced through processes that are highly dependent on cooling water or is generated directly by water as hydroelectricity (IRENA, 2015). Three out of four jobs worldwide are heavily or moderately dependent on water (UNESCO, 2016). Some 1.4 billion workers, or 42 per cent of the world's total active workforce, are heavily water-dependent in sectors such as agriculture, water supply and sanitation, energy, industry, mining and resource extraction; 1.2 billion, or 36 per cent of the world's total active workforce, are moderately dependent in sectors such as construction, recreation and transportation.

Adaptation measures such as investment in the infrastructure required for the conservation, treatment and delivery of water can increase and improve jobs across the economy. Water scarcity and lack of access to clean water may limit economic growth in the coming years (UNESCO, 2016). Investments in water-related infrastructure are a necessary enabling condition for economic growth, jobs and the reduction of inequalities. Investing US$ 1 billion in the expansion of water supply and sanitation networks in Latin America would directly result in 100,000 new jobs (a greater number than would be created by comparable investments in coal-powered energy or rural electrification) (Schwartz, Andres and Dragoiu, 2009). Moreover, a study has shown that villages in Peru with a rehabilitated irrigation infrastructure hired 30 per cent more agricultural workers than comparable villages without such infrastructure, meaning that greater benefits accrued to poor farmers (World Bank, 2013).

Investment in the infrastructure for, and operation of, water-related services can result in direct and indirect job creation. In the United States of America, for example, for each job created in the local water and wastewater industry, 3.68 indirect jobs are created throughout the national economy (Krop, Hernick and Frantz, 2008). Investments in water-related infrastructure need to be planned in consultation with the relevant sectors, such as agriculture, energy and industry, in order to maximize the positive economic and employment-related results.

Although water-related infrastructure investments are generally valuable adaptation measures, they are not necessarily the most cost-effective in all cases, nor will they always lead to the creation of permanent jobs. By contrast, reforestation and afforestation programmes can both provide effective adaptation and generate employment – the former because of the ability of forests to regulate water flows, act as barriers against storm surges, and protect against erosion and mudslides; the latter because the many other ecosystem services provided by forests create jobs and economic value. It is such considerations that underlie, for example, Viet Nam's decision to invest in mangrove reforestation (UNEP, 2013), arguments that have been made in favour of applying the same policy in India to protect coastal areas against cyclones (Das, S. and Vincent, 2009), and the natural capital accounting carried out in Costa Rica to understand better how forests contribute to the country's economy (WAVES, 2015).

Box 2. Adaptation to climate change in Argentina: Actions to prevent the effects of floods and droughts

Floods accounted for about 95 per cent of all economic damage caused by environmental disasters in Argentina in 2016. They affected more than 10 million hectares of land and about 60 per cent of livestock during that year. Numerous urban areas have suffered from flooding in recent years (e.g., Salta in February 2018). Droughts and wildfires (e.g., in the Pampas in February 2018) also pose a real threat to both the population and the economy.

Argentina's National Water Plan ("Plan Nacional de Agua Potable y Saneamiento") provides a framework for coordinating adaptation efforts by both the national government and the provinces. The Plan's objectives go beyond adaptation to extreme weather conditions and include key actions such as investment in the infrastructure for drinking water, sanitation and irrigation, and the construction of dams and water reservoirs aimed at controlling floods, securing water supply and generating hydraulic energy. The plan is expected to reduce the damage caused by floods, droughts and fire, thus leading to greater security, improved health conditions, and increased infrastructural and economic resilience, alongside a positive labour market impact.

The National Water Plan as a whole is expected to attract about US$ 80 billion in investments and to generate 300,000 new jobs by 2021. This includes temporary jobs at different skill levels in the construction sector (e.g., engineers, technical staff, blue-collar workers) and permanent high skill jobs in the management of the early warning systems to be established. Implementation of the Plan should trigger spill over effects on other sectors, creating indirect jobs in manufacturing and services activities along the production chain (e.g., in the production of cement, radars and other equipment). Finally, an economy-wide effect is expected as a result of enhanced consumption and trade at the local level in those areas of the country where the investments will take place. Moreover, the investments should have long-term positive effects on local labour markets because they will reduce vulnerability to disasters and increase resilience.

Source: SSRH (2017).

2.6 Training and skills development as an adaptation measure

Skills development is key to resilience-building and adaptation processes that also ensure decent work. In particular, skills development:

- Helps displaced workers to move on to sectors where there is employment growth, thus protecting them against income losses and other adverse effects of climate change;
- Promotes innovation, investment and competitiveness, which in turn feed back into social development, thus creating a virtuous cycle of sustained and robust resilience; and
- Is required for the adequate implementation of adaptation strategies (e.g., the development of climate-smart infrastructure) (ILO, 2011, 2018a).

Anticipating and monitoring skills needs related to climate change adaptation are crucial first steps in skills development. Of the eleven G20 countries surveyed by the ILO (2018), all indicated that they had established suitable platforms to anticipate skills needs and to provide training in general, but that not all of those platforms were used to discuss the skills implications of the green transition. The active participation of the social partners is useful in identifying skills gaps, implementing training provisions, emphasizing that a higher skill level translates into higher pay, and formally recognizing skills that are acquired on the job.

Skills identification exercises regularly indicate that skills in the STEM (science, technology, engineering and mathematics) fields are the ones most relevant to climate change adaptation (see table 3). The Republic of Korea, through its Green Technology Center, carries out quantitative skills needs assessment for 27 green technology areas, paying particular attention to the actual skill levels of workers in those occupations. Such assessments have revealed that skill levels in the areas closely associated with climate change adaptation tend to be lower than skill levels in other green areas (Jin, forthcoming). In the Russian Federation, climatology-related disciplines have been incorporated into relevant higher education programmes, such as construction and engineering. In addition, the regulations governing the construction sector specify that climate aspects need to be taken into account by all construction employees.

Table 3. Sectors and occupations with high relevance for climate change adaptation

Sector	Occupations / skills (examples)
Agriculture	Agricultural extension; control of plant disturbing organisms; organic agriculture; inspector of organic crop production; inspector of organic livestock production; agricultural engineer
Biodiversity and ecosystem services	Forest ecosystem controller
Built environment	Building of coastal protections; mechanical heating, ventilation and air conditioning systems; brownfield site redevelopment specialist; civil engineer; quantity surveyor; building inspector
Environmental protection and pollution treatment (carbon sinks, etc.)	Desulphurization and denitrification; forest protection and nature conservation; environmental manager; geologist; geophysicist; conservation scientist; environmental scientist; earth and soil scientist; air pollution analyst; environmental engineer; environmental impact and restoration analyst; prediction and modelling of climate change; climate change impact assessment and adaptation; CO_2 capture, storage and, processing; treatment of non-CO_2 GHG emissions; monitoring of harmful substances and purification of the environment
Forestry, husbandry and fishery	Food safety supervisor; forestry technical support personnel; forestry management unit; forest carbon inventory; rehabilitation and reclamation of forest and land; harvesting and storage of seeds of forest plants; watershed management; forestry counsellor; feed quality control; agricultural extension; control of plant disturbing organisms; organic agriculture; inspector of organic crop production; inspector of organic livestock production; brackish water aquaculture; marine safety officer
Public health	Environmental sanitation system planner; food safety supervisor; environmental and occupational health inspector
Transport	Transport manager; transport analyst; road transport manager; aeronautical engineer
Water management	Drinking water management; drinking water supply system operator; maintenance of production units for drinking water treatment; maintenance of water transmission and distribution units; water relief expert; water quality analyst; water treatment plant operator
Waste management (solid waste, electronic waste)	Waste collection and segregation; waste management planner; waste materials plant operator; recycling or rubbish collector; refuse sorter

Source: ILO compilation based on country studies.

Training programmes in support of skills development for climate change adaptation tend to take a sectoral approach. Adaptation-specific programmes have been implemented in the fields of water management, civil engineering and architecture, often through formal education courses at the postgraduate level. Government funding to promote research and development work as well as human resource development in the area of climate change adaptation has supported the provision of training at both public and private institutions.

Bearing in mind that adaptation programmes usually require employment in medium- and low-skilled sectors, training programmes in vocational institutions or for workers in the informal economy may be required. In this regard, South Africa's Expanded Public Works Programme offers several good examples of such interventions in the ecosystem service, biodiversity and water sectors, with a particular focus on skills development for lower-skilled workers, in addition to social protection (see box 4 below). Furthermore, gender mainstreaming in skills development could enable women to move from low-skill and entry-level positions to high-skilled jobs, which would enhance their livelihoods and independence (ILO, 2018a).

2.7 Social protection policies as an adaptation measure

Both developing and developed countries are adapting their social protection systems or developing new schemes to ensure that they offer support that is tailored to the situation of people affected by natural disasters or climate-related events (ILO, 2017b; ILO and AFD, 2016; UNEP, 2016).

Social protection policies can help promote a just transition to a green economy and protect workers against the detrimental effects of climate change and other forms of environmental degradation (ILO, 2015b). Such policies should envisage social and economic measures that protect people over the course of their lives against events that might jeopardize their ability to earn income or access essential services. Social protection enables individuals and families to adapt to the negative consequences of climate change for their livelihoods (ILO, 2017b).[6]

Social protection measures facilitate the adaptation of individuals and families to environmental degradation and climate change. As such they can be used to protect populations that are confronted with adverse environmental events, such as droughts, typhoons, high temperature or floods. Cash transfers and public employment programmes are two specific types of social protection instrument that can be used to help families adapt to extreme climate events.

Cash transfer programmes

Cash transfer programmes are typically designed to address the everyday deprivation faced by households in poverty, or by certain categories of the general population. They are particularly relevant in:

- Strengthening individuals' and households' adaptive capacity in the face of climate change (Béné et al., 2014; Wood, 2011);
- Helping people in poverty meet their basic needs and reducing short-term vulnerability;
- Providing support for households affected by climate-related hardship, such as extreme weather events and slow-onset environmental degradation;
- Reducing pressures to engage in asset-depleting strategies, which weaken long-term adaptive capacity; and
- Increasing the adaptive capacity of vulnerable households by helping them consider investment decisions and innovations (Wood, 2011).

When climate change threatens livelihoods, temporary or permanent migration may be the only response. In this respect, by reducing the costs of migration and providing a degree of insurance to migrants, cash transfers can facilitate mobility and thus increase the options available to vulnerable households for improving their adaptive capacity. More recently, certain climate-sensitive features have been incorporated into pro-poor transfer programmes. Such is the case of Kenya's Hunger Safety Net Programme (see box 3).

6. Social protection measures include family allowances to ensure that parents have sufficient resources to provide good nutrition, education and care for their children; health protection to ensure that ill health does not push people into poverty; unemployment benefits to secure household income in the event job losses; and old-age pensions to ensure that older people can live in dignity.

Box 3. Adding climate-sensitive features to cash transfer programmes: Kenya's Hunger Safety Net Programme

In Kenya, the Hunger Safety Net Programme (HSNP) is an unconditional cash transfer programme that aims to build resilience and reduce extreme poverty in four arid counties located in the northern part of the country.

As of November 2017, the HSNP was providing regular electronic and unconditional cash transfers to 100,883 households*, which represents about 27 per cent of households in the region. The transfers are worth approximately US$ 50 and are paid every two months. Since 2014, measures have been introduced to help the Government of Kenya to scale up cash transfers during periods of drought. Drought conditions are monitored by satellite. If these reach severe levels in any given month, an additional 25 per cent of households in drought-affected areas receive a one-off emergency payment. If conditions worsen to extreme levels, then coverage increases to 75 per cent of all households. During 2015, the HSNP scaled up four times to provide emergency cash transfers to over 207,000 additional households.

The majority of beneficiaries used these cash transfers for food and to meet basic needs, but some were also able to pay off debts, make modest investments in small livestock and contribute to the costs of schooling for their children. There is evidence to suggest that such transfers have enabled the poorer regular beneficiaries to attain a better standard of living, which has also increased their resilience to weather-related shocks. However, emergency beneficiaries used the money much more frequently to cover basic needs rather than to invest in productive assets that might enhance their resilience. Women make up 62 per cent of the recipients, and the programme increased their purchasing power and therefore also their visibility as economic actors, as well as improving their status within their households.

* Against a total target of 101,354 households. See: http://www.hsnp.or.ke/index.php/dashboards/at-a-glance [18 July 2018].

Source: Farhat, Merttens and Riungu, 2017; Otulana et al., 2016.

Public employment programmes

The potential of public employment programmes (PEPs) to combine social and environmental adaptation objectives has been widely recognized. A PEP refers to any government programme that directly creates employment without expanding the regular civil service. Such programmes can contribute to climate change adaptation in different ways:

- Through the security of a predictable income provided to the most vulnerable, and through the work and assets created: for example, adaptation can be targeted by providing employment in flood control and erosion reduction projects;
- Through the incorporation of adaptation measures into projects that enhance community resilience;
- Through emergency employment programmes in vulnerable areas, thus extending the coverage of social protection, while reducing the impact of negative shocks;
- Through anticipatory adaptation: because the majority of PEPs involve the construction of infrastructure, it is possible to integrate such construction projects with climate change adaptation measures.

Boxes 4 and 5 showcase, respectively, the Working for Water programme in South Africa and the Mahatma Gandhi National Rural Employment Guarantee Act in India. They illustrate how PEPs can combine the pursuit of both social and environmental goals.

Box 4. South Africa's Working for Water programme: Social protection and skills development for disadvantaged groups of workers to facilitate their employment in the water management and ecosystem sectors

In order to tackle persistently high unemployment rates, South Africa has implemented a number of active labour market interventions. The Expanded Public Works Programme (EPWP) aims to create employment opportunities* and alleviate poverty, while providing complementary measures such as skills training and social protection for disadvantaged groups of workers. One of the subprogrammes implemented under the EPWP is the Working for Water (WfW) programme, which addresses issues related to water and ecosystem management and the country's needs for employment creation, skills development and social protection.

Currently, more than 300 projects are running under the WfW programme in all nine provinces of the country (DEA, 2018). They provide, for example, short-term job opportunities for unemployed people to work in the removal of water-intensive alien tree and plant species from local water catchment areas. The PEP component of the WfW programme specifically targets vulnerable groups by seeking to employ 60 per cent women, 20 per cent youth and 5 per cent persons with disabilities.

The programme has resulted in the clearance of over 1 million hectares of land invaded by alien plants since 1995, releasing an additional 50 million cubic tonnes of water annually (Schwarzer, van Panhuys and Diekmann, 2016) and contributing to skills development in the water, ecosystem and related sectors (Quinn, 2012; OneWorld Sustainable Investments, forthcoming). Workers participating in the WfW programme receive practical training on techniques for clearing alien vegetation, business skills, health and safety, and social development (Coetzer and Louw, 2012).

* Under Phase 3 of the EPWP (2014–19) the creation of 6 million jobs is envisaged, of which 1.15 million are expected to be in the environment and culture sectors (OneWorld Sustainable Investments, forthcoming).

Box 5. The Mahatma Gandhi National Rural Employment Guarantee Act

The Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) in India is aimed at providing social protection and economic security for rural people in poverty, strengthening drought-proofing and flood management, and empowering marginalized communities. Through the MGNREGA, each rural household is entitled to 100 days of employment a year. People are employed in unskilled manual work, such as the construction or improvement of community infrastructure, or the generation of ecosystem services that protect environmental resources. According to the Ministry of Rural Development, 60 per cent of the work-hours provided through the programme in 2012 involved water conservation and 12 per cent were related to the provision of irrigation facilities (Das, S.K., 2013). The programme also increasevd female labour participation and, in some cases, also women's autonomy in household decision-making by providing them with higher wages than those offered by other rural jobs (ILO, 2017b).

A macroeconomic simulation performed using the United Nations Global Policy Model suggests that a policy mix aimed at extending the provision of social transfers (through such mechanisms as unemployment benefits, cash transfers, PEPs and payment for ecosystem services), strengthening social protection and supporting green investment is financially viable and conducive to higher growth, employment creation and a fairer distribution of income. In terms of employment, the results of the study suggest that by 2030, the last year of the projections, the extension of social transfers could lead to an increase in employment rates of 0.2 per cent in developed countries and 0.6 per cent in developing countries (ILO, 2018a).

3. Accompanying and enabling policies to maximize the positive employment effect of the transition to a climate-resilient economy

This section highlights how complementary policies can enhance the employment creation potential of adaptation policies. It describes, in some detail, how a legal framework that integrates environmental with labour-related objectives can help make climate change adaptation and mitigation measures more employment friendly. Similarly, social dialogue ensures that the interests and needs of the relevant stakeholders are taken into account, both when defining solutions and in their implementation. This section also discusses other aspects relevant for the effective development and implementation of adaptation measures, including the role of micro-, small and medium-sized enterprises, and the importance of sharing best practices and improving tools and methods to identify the employment benefits specifically attributable to adaptation investments.

3.1 Key messages

The following measures are among those that could be deployed, as appropriate and relevant, to increase the positive impacts of climate resilience on employment:

- A national legal framework that integrates environmental with labour-related objectives can go a long way towards ensuring that climate change adaptation and mitigation measures are also employment friendly.
- Social dialogue can play an important role in maximizing the employment effect of adaptation to climate change. It is important to give due consideration to international labour standards when designing climate change adaptation policies.
- Micro-, small and medium-sized enterprises are important partners in climate change adaptation because they are well placed to develop locally relevant effective adaptation solutions.
- Sharing best practices and improving tools and methods for identifying the employment benefits specifically attributable to adaptation investments would help to ensure that any such investments lead to productive and inclusive growth. This could be done, for example, by systematically comparing the employment outcomes of investments that include an adaptation component with those of investments that do not. Another possibility is to include green jobs in labour force surveys, which would account for jobs in mitigation- and adaptation-related activities. There are several methodologies available for assessing employment impacts along these lines, such as that developed by the Green Jobs Assessment Institutions Network (GAIN).

3.2 The ILO guidelines for a just transition

The ILO (2015b), through a process of consultation that brought together governments and worker and employer representatives, has developed a comprehensive set of guidelines for policy-makers to ensure that adaptation and mitigation measures are conducive to sustainability on an economic and social level (box 6).

Box 6. The ILO Guidelines for a just transition towards environmentally sustainable economies and societies for all

The *Guidelines for a just transition towards environmentally sustainable economies and societies for all* (2015), developed by the ILO through tripartite discussion, can be used to ensure that no workers are left behind during the transition to a green economy, and that the transition also strengthens decent work. These guidelines offer a portfolio of policy options for addressing the issues associated with the greening of the economy and the workplace and, more broadly, with the transition towards sustainable development.

The guidelines encourage governments to develop national policies and plans for mitigation of, and adaptation to, climate change, as well as for disaster preparedness, in consultation with business associations, workers' organizations and other stakeholders in order to strengthen resilience to the impacts of climate change and promote disaster preparedness information and insurance.

Source: ILO (2015b).

3.3 Integrating decent work objectives with environmental objectives

A number of G20 countries have begun to incorporate objectives from the ILO's Decent Work Agenda into their environmental policies, notably into their nationally determined contributions (NDCs) under the Paris Agreement. For example, Brazil, India and South Africa included a reference to decent work outcomes in their NDCs. The NDCs for Australia, Canada, France, Germany, Japan and the United Kingdom make indirect reference to the world of work. Through their NDCs, some G20 countries have integrated Decent Work in the form of specific measures aimed at protecting vulnerable populations (e.g., Brazil, India, Indonesia, Mexico), enhancing adaptive capacity (e.g., China, India, Indonesia, Saudi Arabia), raising awareness (e.g., India, Indonesia), and strengthening the resilience of sectors with vulnerable livelihoods while facilitating the transition to a climate-resilient social structure (e.g., Republic of Korea) (ILO, 2018a).

International labour standards can strengthen adaptation frameworks by providing the legal foundation for addressing rising inequality and the increasing vulnerability of workers and enterprises in the face of climate change, as well as for enhancing the adaptive capacity of communities. They are international legal instruments drawn up by representatives of governments, employers and workers – the ILO's constituents – which set out basic principles and rights at work. International labour standards, such as the Employment and Decent Work for Peace and Resilience Recommendation, 2017 (No. 205), can help attract and consolidate international cooperation in areas such as capacity building, financing and technology transfer. Table 4 illustrates how international labour standards provide policy solutions for dealing with the effects of climate change on communities, workers and enterprises while ensuring the promotion of decent work.

Table 4. International labour standards relevant to climate adaptation and mitigation policies

Adaptation policies	Mitigation policies
Environmentally induced stress at work: • **Hazardous air quality**: C.148 (Working Environment (Air Pollution, Noise and Vibration)); • **Measures to cope with heat and other stress at work**: C.110 (Plantations), R.116 (Reduction of Hours of Work); • **Occupational safety and health (OSH)**: C.155 and P.155 (OSH), C.187 (Promotional Framework for OSH), C.161 (Occupational Health Services).	**Enhancement of adaptive capacity:** • **Poverty reduction**: various international labour standards, including those dealing with fundamental rights at work, employment, social security and OSH; • **Improving education/knowledge and skills**: C.140 (Paid Educational Leave), C.142 (Human Resources Development); C.155 and P155 (OSH); • **Promoting the rights of groups vulnerable to climate change**: C.111 (Discrimination), C.159 and R.168 (Vocational Rehabilitation and Employment (Disabled Persons)), C.183 (Maternity Protection), C.169 (Indigenous and Tribal Peoples).
Compensation and protection for workers in affected sectors: • **Unemployment**: C.102 (Social Security (Minimum Standards)), C.168 (Employment Promotion and Protection against Unemployment); • **Compensation for the victims of pollution and other environmental damage**: R.181 (Prevention of Major Industrial Accidents); • **Compensation for removal from traditional lands**: C.169 (Indigenous and Tribal Peoples); • **Minimum levels of benefits for workers facing an accident or illness related to work**: C.121 and R.121 (Employment Injury Benefits), R.202 (Social Protection Floors).	**Prevention of damage to the environment:** • **Prevention and protection measures**: C.162 and R.172 (Asbestos); C.176 (Safety and Health in Mines); R.192 (Safety and Health in Agriculture); • **Environmentally sound management of pollution and waste disposal**: C.162 and R.172 (Asbestos), C.170 and R.177 (Chemicals), C.184 and R.192 (Safety and Health in Agriculture); • **Environmental impact assessment**: C.169 (Indigenous and Tribal Peoples).
Environmentally induced displacement (migration): • **Labour migration specific standards**: C.097 (Migration for Employment), C.143 (Migrant Workers), R.100 (Protection of Migrant Workers); R.151 (Migrant Workers).	**Reduction of greenhouse gas emissions:** • **Agriculture related:** C.184 and R.192 (Safety and Health in Agriculture); • **Mining related**: C.176 and R.183 (Safety and Health in Mines).
Measures to address disasters: • **Preparedness for and response to industrial disasters**: C.174 (Prevention of Major Industrial Accidents); • **Preparedness for and response to natural disasters and other crisis situations**: R.205 (Employment and Decent Work for Peace and Resilience).	**Sectoral policy measures:** • **Agriculture**: C.184 and R.192 (Safety and Health in Agriculture); • **Chemicals**: C.170 and R.177 (Chemicals); • **Waste management**: C.170 and R.177 (Chemicals), C.184 and R.192 (Safety and Health in Agriculture).
Diversification of economies and redress of inequality: • **Employment policy**: C.122 (Employment Policy), R.189 (Job Creation in Small and Medium-Sized Enterprises), R.198 (Employment Relationship), R.205 (Employment and Decent Work for Peace and Resilience); • **Skills**: C.140 (Paid Educational Leave), C.142 (Human Resources Development).	**Sustainable patterns of production and consumption:** • **Elimination or reduction of production processes that may damage the environment, and respect for ecological thresholds as well as waste minimization:** C.148 (Working Environment (Air Pollution, Noise and Vibration)), C.162 (Asbestos), C.169 (Indigenous and Tribal Peoples), C.170 (Chemicals), C.174 (Prevention of Major Industrial Accidents), C.176 (Safety and Heath in Mines), C.184 (Safety and Health in Agriculture).
Cross-cutting international labour standards	
Social dialogue: • C.087 (Freedom of Association and Protection of the Right to Organise), C.098 (Right to Organise and Collective Bargaining).	**Skills development:** • C.140 (Paid Educational Leave), C.142 (Human Resources Development), C.155 and P.155 (OSH).

Source: ILO compilation based on NORMLEX.

3.4 Consultation and social dialogue

Social dialogue can play an important role in adaptation to climate change. For example, as a result of increased temperatures and the risk of heat stress, indoor and outdoor working conditions and work-hours may need to be adjusted, implying changes to dress codes, uniforms and equipment as well as to the length of shifts and breaks. As already noted, workers and employers need to be involved, together with governments, in the development of mitigation and adaptation policies because these have a direct impact on working conditions and the world of work. In many instances related to the development and implementation of adaptation policies, workers and employers are best placed to take appropriate action in the workplace, such as ensuring compliance with health and safety standards during emergencies, finding practical solutions to enable workers to continue to do their jobs, and continuously exploring new ways of coping with the effects of climate change (TUC, 2009). Box 7 provides an example of how community engagement has led to successful employment outcomes in Indonesia.

Collective agreements at the national level are beginning to include climate change-related provisions. Most national agreements that address environmental concerns focus explicitly on greening the workplace and actions that may have adaptation co-benefits. One example of a collective agreement that reflects issues related to climate change adaptation very clearly is Australia's Green Skills Agreement (2009) between the federal Government and state and territory governments, which was the result of negotiations that included the participation of the social partners. Another example is a collective agreement between the University of British Columbia and the Canadian Union of Public Employees (2014), which stipulates that, when a workplace is closed temporarily owing to environmental conditions, employees are to receive their regular salary during the closure.

Box 7. Community engagement and employment opportunities in the restoration of forest land in Indonesia

Forest land covers 60% of Indonesia's land area, making it the third largest area of tropical rainforest in the world. The Indonesian Government has set ambitious targets for reducing CO_2 emissions caused by deforestation and for conserving forests as part of its commitments under the Paris Agreement. Indonesia also aims to maximize the development and employment growth impact of adaptation measures by building on community empowerment.

Launched in 1996, the Mega Rice Project in Central Kalimantan resulted in over one million hectares of peat swamp forest being drained for conversion into rice paddies. After the peat was drained and canals were built, it was found that the soil conditions were not suitable for intensive agriculture. Much of the peatland was either abandoned or turned into palm oil plantations; in some cases, it also ended up being used by indigenous peoples for smallholder farming. The degraded land burns frequently, leading to transboundary haze, high levels of GHG emissions and increased livelihood vulnerability.

Successful efforts to restore and conserve the area began in 2007. One of the key principles that contributed to the successful socio-economic development achieved was community empowerment, notably the participation of communities in the design and implementation of activities. One such activity was the GLACIER (Green Livelihood Access for Central Kalimantan's Inclusive Environmental Response to Climate Change) project, which ran for 12 months from 2012 to 2013. The actions undertaken under that project included the assessment of canal blocking, fire prevention, agroforestry and investments in environmental infrastructure.

Based on participatory decision-making that also maximized employment opportunities, the GLACIER project created temporary jobs for members of the local communities, while infrastructure investments improved the communities' access to livelihoods, public facilities, such as schools and community health clinics, as well as to markets outside their villages. These outputs have helped overcome the many challenges to sustainable development in Central Kalimantan, among which are the fight against illegal logging, fire management, drainage of peatland, achieving sustainable cultivation and expansion of plantations, and the need to combat encroachment on protected and conservation areas as well as illegal mining.

Source: ILO (2013b).

Apart from national level collective agreements, there are also international framework agreements (IFAs), which are voluntary instruments negotiated between multinational enterprises and Global Union Federations. Some IFAs contain provisions that deal expressly with climate change adaptation. The IFA signed by GDF Suez, for example, actively supports the principles of a just transition, stipulating that any necessary adaptation should take place "in a way that protects the rights and interests of workers" and that any such changes should be "designed and implemented in an agreed, fair manner". The IFA signed by the Renault Group calls upon all of its employees to implement, inter alia, actions that "necessitate the adaptation of skills with regard to … major environmental challenges".

3.5 Micro-, small and medium-sized enterprises are key actors in adaptation

Micro-, small and medium-sized enterprises (MSMEs) have a vital role to play in ensuring the livelihoods of communities because the investments they make mostly affect their local surroundings. MSMEs are in a unique position to develop locally relevant, effective adaptation solutions which can increase the resilience of societies as a whole. Engaging the private sector, and MSMEs in particular, in the development and implementation of adaptation measures will make these more likely to succeed.

One successful example of such engagement is the Climate Expert risk assessments developed for the MSME sector by the German Agency for International Cooperation (GIZ). This assessment is comprehensive in that it considers both the direct impacts of climate change on such enterprises' buildings, processes, logistics, stock, employees and surrounding communities, and the indirect impacts arising from altered conditions in the market, financial landscape and regulatory environment.[1]

3.6 Improving tools and methods to evaluate the relationship between adaptation policies and job creation

Tools and methods should be developed to identify the employment benefits specifically attributable to adaptation investments. The specific employment-creation potential of infrastructure adaptation policies is difficult to assess because such policies are usually embedded in more general infrastructure maintenance and development programmes. Such assessment could be performed, for example, by systematically comparing the employment outcomes of investments that include an adaptation component with those of investments that do not. Another possibility is to include green jobs in labour force surveys, which would account for jobs in mitigation- and adaptation-related activities. Dedicated guidelines for capturing data about green jobs in labour force surveys have been adopted by the International Conference of Labour Statisticians (ILO, 2013c).

Any tools and methods used to evaluate the employment impact of adaptation infrastructure need to take into account the benefits of averted damages and averted job losses. Adaptation to climate change, particularly when the focus is on built infrastructure, may seem expensive, but on the other hand it does clearly bring employment benefits. Another aspect worth considering is that the development of physical infrastructure may not be the most cost-effective adaptation strategy in some cases.

1. The assessment is part of the Climate Expert approach developed under the GIZ programme "Strengthening the Capacities of the Private Sector to Adapt to Climate Change" on behalf of the German Federal Ministry for Economic Cooperation and Development. The programme aims to provide MSMEs with tools that they can use to strengthen their resilience. The approach was tested in four different countries: Bangladesh, Costa Rica, Morocco and Rwanda (GIZ, 2015).

The number of jobs created by labour-intensive adaptation programmes is one key measure of their impact, but other considerations also matter (e.g., the opportunities such programmes generate for overcoming income and gender inequality, and the benefits they bring to disadvantaged population groups other than women). The stability and career prospects of the jobs created are important factors, too, as is the protection offered to workers in terms of occupational safety and health and social security. The emphasis should be on creating more jobs in order to achieve inclusive growth, provide productive work, and ensure income security in the workplace, social protection and equality of opportunity and treatment.

3.7 Sharing best practices

Assessments of green jobs reveal the labour market implications of the transition to a green economy and can thus be used to guide policy-making.

There are several methodologies available for assessing the employment impact along these lines, including the one developed by the Green Jobs Assessment Institutions Network (GAIN). These methodologies can be used to identify sectoral entry points for investment to promote green jobs nationally, as well as to inform policy formulation by setting specific goals and targets (ILO, 2017a). Platforms such as the Partnership for Action on Green Economy (PAGE) provide opportunities to share relevant national experiences together with tools and methodologies for impact assessment. Many cities and local governments are also involved in networks established specifically for the purpose of sharing best practices. For example, the C40 Cities Climate Leadership Group is a community of practice that aims to identify solutions, share lessons learned, and provide assistance to local policy-makers.

Various countries, including Brazil, Germany, India, Indonesia, Malaysia, Mauritius, Mexico and Tunisia have undertaken assessments of green jobs and shared their experiences during the International Research Conference "Assessing Green Jobs for Evidence-Based Policy Making" held in 2013 at the International Labour Office's headquarters in Geneva (ILO, 2013a).

Conclusions

All forms of environmental degradation directly and negatively affect the world of work. The deterioration of the environment endangers the provision of ecosystem services and the jobs that depend on them. In particular, the increasing frequency and intensity of natural disasters caused or exacerbated by human activity have already reduced labour productivity. Increases in temperature in the years to come will have a similar effect. Although mitigation strategies can help to limit future adaptation costs, climate change adaptation is a matter of urgency and needs to be undertaken without delay.

Adaptation measures can lead to employment gains and prevent job losses. Such measures include natural and physical infrastructure as well as skills development programmes and social protection policies. A comprehensive study of the relationship between the number and quality of jobs, on the one hand, and climate change adaptation, on the other, is thus urgently called for. In all cases, social dialogue that brings together governments, workers and employers (notably MSMEs) can enhance the local relevance and effectiveness of adaptation plans.

Investment in adaptation infrastructure is likely to have positive employment effects by increasing demand for construction work in projects aimed at reducing climate-related risks. However, it is not easy to identify the specific employment effects in this area, because infrastructure is not usually constructed for adaptation purposes alone. Climate-proofing features tend to be incorporated into existing infrastructure as part of periodic maintenance and upgrading activities, making it difficult to track their employment effects. It is thus quite possible to overestimate the specific contribution of climate change adaptation to employment, and more detailed analyses of the relationship between the two would therefore be necessary.

Social protection and skills development policies are other forms of climate change adaptation that need to be considered in any adaptation strategy. They increase adaptive capacities and can protect individuals and communities faced with natural hazards against income and food insecurity. They can also help displaced workers and workers directly affected by climate-related hazards. By providing food and income security, such policies promote economic activity and employment, albeit indirectly. More generally, the labour regulatory framework can support adaptation policies by offering solutions to cope with environmentally induced stress at work, environmentally induced migration, and the challenge of providing compensation and protection for workers in the sectors affected, as well as by making tools available for the diversification of economies.

Further research is required to improve our understanding of which adaptation measures produce the best employment results in various settings and for different levels of vulnerability to climate change. One has to take into account not only the various types of adaptation measures, but also the social, economic and institutional contexts that favour positive employment outcomes. In certain countries, for example, investment in adaptation infrastructure can yield better results during periods of economic downturn.

Existing platforms like GAIN and PAGE should be used to share best practices and improve the tools and methods for identifying the employment benefits that are specifically attributable to adaptation investments.

Acronyms

AFD	French Agency for Development
ASCE	American Society of Civil Engineers
CIAT	International Center for Tropical Agriculture
CO_2	Carbon dioxide
EPWP	The Expanded Public Works Programme
ECLAC	Economic Commission for Latin America and the Caribbean
FAO	Food and Agriculture Organization
GAIN	Green Jobs Assessment Institutions Network
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GIZ	German Agency for International Cooperation
GLACIER	Green Livelihood Access for Central Kalimantan's Inclusive Environmental Response to Climate Change
HSNP	Hunger Safety Net Programme
IEA	International Energy Agency
IEEP	Institute of European Environmental Policy
IFA	International Framework Agreement
ILO	International Labour Organization
IPCC	Intergovernmental Panel on Climate Change
IRENA	International Renewable Energy Agency
ISO	International Organization for Standardization
ITUC	International Trade Union Confederation
MGNREGA	Mahatma Gandhi National Rural Employment Guarantee Act
MSME	Micro-, Small and Medium-sized Enterprise
NDC	Nationally Determined Contribution
OECD	Organisation for Economic Co-operation and Development
PAGE	Partnership for Action on Green Economy
PEP	Public Employment Programme
STEM	Science, Technology, Engineering and Mathematics
TUC	Trade Union Congress
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
WAVES	Wealth Accounting and the Valuation of Ecosystem Services
WBGT	Wet Bulb Globe Temperature
WIOD	World Input–Output Database
WfW	Working for Water

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